

REMARKS

Examiner Interview

Applicants would like to thank the Examiner for the courtesy extended Applicants' representative in a telephonic interview on July 8, 2003. The remarks herein are consistent with the discussion during that interview.

Claim Rejections

In a Response to Final Office Action mailed May 20, 2003, Applicants noted that Havemann (U.S. Patent No. 6,156,651) does not teach filling a contact via as recited by the pending claims. In particular, Applicants noted that Havemann does not teach filling the vias to the recited levels. In response, in the Advisory Action mailed on June 16, 2003, the Examiner stated that "Havemann does teach the above limitation (see figures 4b, col. 5, lines 54-58, not[ing] that less [than] the height of the inner level dielectric [is filled,] which can be interpret[ed] as [filling] between about one-third and[] two thirds of the height of the via").

Applicants respectfully traverse the rejections and submit that the pending claims distinguish the art of record. Because the Examiner's remarks appear to address both anticipation and obviousness, each basis for rejection is discussed in turn below.

Anticipation Rejections

The Examiner appears to have rejected Claims 2, 5-9 and 17-20 under 35 U.S.C. § 102(e) as being anticipated by Havemann (U.S. Patent No. 6,156,651).

Initially, Applicants note that independent Claims 6 and 17 recite "depositing the first metal comprises filling the contact via to a height between about *one-third* and *two-thirds* of a height of the contact via" and "depositing a first metal to fill between about *one-thirds* and *two-thirds* of the height of the contact via," respectively. The "first metal" is recited as being less conductive than the "second metal" that fills the contact via over the "first metal."

In contrast, the passage of Havemann cited by the Examiner states that:

selective deposition fills the via to *less than* the height of the inner level dielectric
30. While the selective deposition can be stopped prior to the via metal reaching

the top of the intralevel dielectric 30, the selective deposition could also be continued to over the top of the intralevel dielectric 30 and then an etch back process used to reduce the metal level back to *below the top* of the dielectric 30.

Havemann, Col. 5, lines 54-56 (emphasis added). Consequently, Havemann teaches less than complete filling of the contact via, but does not teach specifically filling “between about one-thirds and two-thirds” of the contact via height. Rather, Applicants submit that less than complete filling of the contact via can include, *e.g.*, 0.00001 to 99.99999% filling of the contact via and does not necessarily include “between about one-thirds and two-thirds” of the contact via height.

Applicants note, however, that to establish anticipation, each element of a claim must be found, either *expressly* or under principles of *inherency*, in a single prior art reference. *See In re Robertson*, 169 F.3d 743, 745, 49 U.S.P.Q.2d 1949, 1950-51 (Fed. Cir. 1999). With respect to Havemann, while a large range that includes the claimed range is taught, the claimed range is not *expressly* taught. As such, Applicants submit that Havemann does not expressly anticipate Claims 6 or 17, since Havemann does not explicitly teach the recited range.

To inherently anticipate, the missing matter must be “*necessarily* present in the thing described in the reference.” *Id.* (emphasis added). Havemann, however, does not provide any particular indication that the contact via should be filled to the presently claimed levels. Moreover, practicing Havemann’s teachings does not necessarily lead to filling the contact via to the presently claimed levels, since Havemann’s teachings can be practiced by filling the contact via to levels outside of Applicants’ claimed levels, *e.g.*, less than about one-thirds and or more than about two-thirds of the contact via height. Consequently, Applicants submit that practicing Havemann’s teachings does not *necessarily* lead to filling within the range recited in Claims 6 or 17 and, so, also does not inherently anticipate those claims. *See also In re Rijckaert*, 9 F.3d 1531, 28 U.S.P.Q.2d 1955 (Fed. Cir. 1993) (ruling that a claim to an apparatus which provides a “time compression of the signal blocks by a factor of $\alpha \cdot n / (180 \cdot (M+1))$ ” is not inherently disclosed, even where the prior art disclosed the device generally and could meet this limitation when operated under optimal conditions, because the prior art did not suggest manipulating these variables).

In addition, Applicants submit that the Examiner has misinterpreted Havemann. The Examiner refers to Havemann's statement at Col. 3, lines 19-21 as teaching the combination of metals recited in the pending claims; Havemann states that: "[t]he conductors and vias of this invention will generally be either copper, tungsten or aluminum *or combinations thereof*." (emphasis added). Applicants submit that the phrase "combinations thereof" actually refers to a single material, *e.g.*, an alloy, and does not refer to different relatively pure "metal[s]" arranged over one another. This meaning of "combinations thereof" is made explicit in the claims, which recite "depositing a first conductor metal" "wherein *said* conductor metal consists of essentially aluminum, tungsten, copper or *combinations thereof*." See Havemann, Claims 1, 4, 12 and 20 (emphasis added). Clearly, as indicated by the claims, Havemann teaches a single combined metal and it is this single metal that can be formed of combinations of aluminum, tungsten, or copper. Consequently, Applicants respectfully submit that "combinations thereof" refers to aluminum, tungsten, or copper blended together to form a single conductive metal, rather than aluminum, tungsten, or copper deposited in discrete layers over one another, as recited in the claims.

Accordingly, Applicants respectfully submit that Havemann does not anticipate Claims 6 or 17, either expressly or inherently.

Obviousness Rejections

The Examiner appears to have also maintained her earlier rejections of Claims 3-4, 10 and 21-23 under 35 U.S.C. § 103 over Havemann in view of various other references. The Examiner has previously stated that Havemann was applied as asserted for anticipation above and has applied the other references to satisfy various deficiencies of Havemann.

As discussed above, however, Havemann does not teach all that has been asserted. Havemann does not teach filling the contact via to the particular levels recited in independent Claims 6 and 17, nor does Havemann teach forming two different metals over one another, the "first metal" less conductive than the "second metal." Because the obviousness rejections depend upon the asserted teachings, Applicants respectfully submit that these rejections are moot in view of the comments above.

Applicants also note that, while not explicitly stated, it appears that the Examiner has not found the limitation of filling "between about one-thirds and two-thirds" of the contact via height to be patentably distinguishing because Havemann teaches a range that includes Applicants' narrower claimed range. As discussed above, however, Havemann does not expressly teach Applicants' claimed range, nor, given that Havemann's range is substantially larger than Applicants' claimed range, would practicing Havemann necessarily result in filling a contact via to Applicants' recited levels. As such, it cannot be said that Havemann anticipates Applicants' claimed invention.

Consequently, it appears that the Examiner believes that, because the claimed levels are encompassed within the larger range of Havemann, it would have been obvious to optimize Havemann to match the levels specified by Applicants. Applicants note, however, that even where a claim recites a range that is included in a larger prior art range, the claim can still be patentable where an applicant has shown the criticality of a claimed range and where the prior art does not recognize the importance of the narrower range.

Such a situation is discussed in *In re Antonie*, 559 F.2d 618, 195 U.S.P.Q. 6 (C.C.P.A. 1977). In that case, the PTO rejected a claim directed to a wastewater treatment device that recited a particular "ratio of tank volume to contractor area of 0.12 gal./sq. ft.³." The court stated that the prior art reference "teaches the basic structure of the device claimed by appellant but is silent regarding quantitative design parameters other than to give data on a single example." The Court stated:

It is impossible to recognize, from the experiment taught by [the prior art], that 'treatment capacity' is a function of 'tank volume' or the tank volume-to-contractor area ratio. Recognition of this functionality is essential to the obviousness of conducting experiments to determine the value of the 'tank volume' ratio which will maximize treatment capacity ... The experiments suggested by the [prior art] do not reveal the property which applicant has discovered, and the PTO has provided us with no other basis for the obviousness of the necessary experiments.

Id. (emphasis in original) (internal citations omitted). Consequently, although the prior art generally disclosed a similar structure, the Court found that the recitation of the numerical limitation of the “tank volume to contractor area” ratio was distinguishing because, although the prior art device *could* be built to satisfy this limitation, the prior art did not recognize the importance of this ratio and provided no suggestion to build a device with such dimensions.

Similarly, in *In re Rijckaert*, 9 F.3d 1531, 28 U.S.P.Q.2d 1955 (Fed. Cir. 1993), the Federal Circuit reversed the PTO’s rejection of a claim directed to an electronic recorder. The claim recited a “time-base correction circuit provid[ing] a time expansion or time compression of the signal blocks by a factor of $\alpha \cdot n / (180 \cdot (M+1))$.” The Court indicated that, together, two prior art references showed the recorder generally and that “fulfilling the claimed relationship” was a condition for optimally operating the recorder. The Court stated, however, that:

in affirming the rejection, the Board first assumed that the claim limitation at issue, the relationship between time expansion/compression and the three variables, was somehow ‘inherent’ in the prior art ... The Board also assumed specific values in order to assert that [the prior art] satisfies the claimed relationship ... While the condition described may be an optimal one, it is not ‘inherent’ in [the prior art]. Nor are the means to achieve this optimal condition disclosed by the [prior art], explicitly or implicitly. The mere fact that a certain thing *may* result from a given set of circumstances is not sufficient ...

Id. (emphasis in original) (internal citations omitted). Thus, the Court found that the recitation of the numerical relationship was distinguishing because the prior art did not recognize this relationship nor did it provide any suggestion to meet this numerical limitation, even though the prior art disclosed the general features of the claimed invention. *See also In re Woodruff*, 919 F.2d 1575, 16 U.S.P.Q. 2d 1362 (Fed. Cir. 1997) (“the law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims”).

Similarly, in the present case, Applicants have taught the criticality of and claimed a particular numerical limitation. The presently claimed range of “between about one-thirds and

two-thirds” of the contact via height has not simply been arbitrarily selected. Rather, Applicants have found that less conductive metals are generally easier to deposit uniformly, whereas more conductive metals are more difficult to deposit into contact vias. To facilitate deposition of the more conductive metal, Applicants have found that the contact via floor can effectively be raised by depositing a less conductive metal before depositing the more conductive metal. Applicants have also recognized the deleterious effect of the identity of these metals on the conductivity of the resultant structure. In response, Applicants have found that filling “between about one-thirds and two-thirds” of the contact via height represents a particularly advantageous balance between these disparate considerations. *See, e.g.*, pp. 8 and 11 of the Application.

In rejecting the claims, the Examiner has pointed to Havemann, which at best teaches the filling of a contact to a level that *may* fall within Applicants claimed range. Havemann, however, does not recognize the relationship between the composition of the deposited metals, the conductivities of the metals, the deposition behavior of the metals and the effect of the filling levels of the metals on the resultant integrated circuit or contact plug. Rather, Havemann simply discloses filling a contact via less than completely, without any teaching concerning why a particular level of filling should be performed. As such, given Havemann’s complete lack of guidance regarding particular filling levels, Applicants submit that Havemann cannot be said to teach or suggest the particular levels of filling recited in the pending claims. As with *In re Rijckaert* and *In re Antonie*, Applicants submit that the “mere fact that a certain thing *may* result from a given set of circumstances is not sufficient,” especially where Havemann “do[es] not reveal the property which applicant has discovered.” Consequently, Applicants respectfully submit that the rejections of Claims 6 and 17 are improper and run counter to established principles of patent law.

Accordingly, Applicants respectfully submit that the pending claims are allowable over the art of record. Applicants have not specifically addressed the rejections of dependent claims as being moot in view of the remarks herein, nor have Applicants specifically addressed the asserted teachings of the art of record apart from Havemann. However, Applicants expressly do not acquiesce in the Examiner’s findings not addressed herein. Moreover, Applicants submit that the dependent claims recite further distinguishing and non-obvious features of particular utility.

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CONCLUSIONS

In view of the foregoing amendments and remarks, Applicants request entry of the amendments and submit that the application is in condition for allowance and respectfully request the same. If some issue remains which the Examiner feels may be addressed by Examiner's amendment, the Examiner is cordially invited to call the undersigned for authorization.

Respectfully submitted,

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